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METHOD FOR ORIENTING A LIQUID CRYSTAL DISPLAY ELEMENT
[Ekisho Hyoji Soshi no Haiko Shori Hoho]

Katsuyuki Inoue

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Inventor : Katsuyuki Inoue

Applicant : Toshiba Electric Corp.

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Specification

1. Title of the invention

Method for orienting a liquid crystal display element

2. Patent Claims

1. A method for orienting a liquid crystal display element characterized, with regard to a liquid crystal display element constituted by sandwiching a liquid crystal layer in-between a pair of transparent substrates formed by plastic films wherein display electrodes have been configured on the respective inner wall planes thereof, by the fact that a horizontal orienting treatment for the aforementioned substrates is performed by pressing, onto the aforementioned substrates, an orienting component in possession of large numbers of microscopic channels bearing a directionality on the surface thereof and by transferring, onto the former, said channels.

2. A method for orienting a liquid crystal display element specified in Claim 1 wherein said orienting component is pressed, in a heated state, onto said substrates.

3. A method for orienting a liquid crystal display element specified in Claim 1 wherein said orienting component is provided by forming channels on the flat plane thereof and wherein said flat plane is pressed onto the substrate plane for simultaneously transferring said channels onto the entire substrate plane.

3. Detailed explanation of the invention

(Technical fields of the invention)

The present invention concerns a method for orienting a liquid crystal display element designed to use, as substrates, transparent plastic films.

¹ Numbers in the margin indicate pagination in the foreign text.

(Technical background of the invention)

A liquid crystal display element known in the prior art is constituted by configuring a pair of transparent glass substrates wherein display electrodes have been configured on the respective inner wall planes thereof in opposition & in parallel to one another, by sandwiching, in-between them, a liquid crystal layer with a thickness of approximately 10 μm , and by adhering & sealing the substrate peripherals by using a sealing adhesive, and it has been used, by impressing a voltage onto said display electrodes from an external source, for displaying arbitrary characters, patterns, etc.

Such a liquid crystal display element is subjected, either for enhancing the display quality or due to the action principle thereof, to a horizontal orienting treatment whereby the long axial $\frac{1}{2}$ directions of liquid crystal molecules sandwiched in-between a pair of glass substrates are aligned along a uniform direction parallel to the glass substrate planes.

One horizontal orienting method practiced in the prior art is shown in Figure 1, for example, according to which a cylindrical rotor (2) into which a brush (1) comprising of fine fibers of nylon, polyester, carbon, glass, cotton, etc. have been implanted at a high density is rotated along the direction of the arrow (3) at a high speed, and the surface of the display electrode (4) is rubbed by mobilizing, along the direction of the arrow (7), a glass substrate (7) on which the external connection terminal (5) has been configured for forming, at a high density, scratches fine to the extent of being virtually invisible. These fine scratches are impressed in parallel to the arrow (7), whereas the long axial directions of liquid crystal molecules contacted with said scratches become uniformly aligned in parallel to said scratches.

In recent years, the prospect of substituting the aforementioned glass substrate with a plastic film has been investigated by manufacturers of liquid crystal display elements for the purpose of reducing product costs. At present, polyesters are being generally used as plastic films, whereas thin films of indium oxide or gold are being used as transparent electrodes.

(Problems of the background technology)

In a case where such a plastic film is used for a liquid crystal display element, several problems are unavoidable. The life of a water-permeable display element, for example, is short, whereas the contiguity of a polyester film with an indium oxide or gold transparent electrode is inferior. Even in a case where a polyester film is used in place of a glass as the substrate of a liquid crystal display element, the horizontal orienting treatment whereby the long axial directions of liquid crystal molecules are aligned along a uniform direction parallel to the substrate is necessary and indispensable.

The horizontal orienting treatment is executed, as has been explained with reference to Figure 1, by means of rubbing, along a uniform direction, with a fine fiber brush being rotated at a high speed, although it has been determined that this rubbing treatment is flawed in that the indium oxide or gold transparent electrode adhered to the polyester film becomes peeled and depleted.

(Objective of the invention)

The present invention provides a method for orienting a liquid crystal display element capable of solving the problem of the case where a plastic film is used as a substrate, namely the peeling of an electrode there from as a result of rubbing.

(Summary of the invention)

The present invention is characterized by the fact that a horizontal orienting treatment for the aforementioned substrates is performed by pressing, onto substrates on which display electrodes have been formed, an orienting component in possession of large numbers of microscopic channels bearing a directionality on the surface thereof and by transferring, onto the former, said channels. In this case, it is effective to use said orienting component in a heated state.

(Effects of the invention)

The horizontal orienting treatment of the present invention is performed by means of so-called “press transfer” without recourse to rubbing, and therefore, it becomes possible to avoid the peeling of an electrode bearing an inferior contiguity in relation to a plastic film substrate.

(Application examples of the invention)

Figure 2 is a cross-sectional diagram provided for explaining an application example of the present invention.

To explain with reference to said figure, a polyester film (8) with a thickness of 100 μm may, for example, be used as a plastic film, whereas configured on one plane thereof are the transparent electrode (9) comprising of indium oxide bearing a resistance value of $300 \Omega/\square$ and the external connection terminal (10). A panel (11) made, for example, of a metal, glass, etc. is configured, as a horizontal orienting component, in opposition to the transparent electrode (9) and virtually in parallel to the polyester film (8).

The plane of this panel (11) made of a metal, glass, etc. and facing the polyester film is flat, and large numbers of channels (12) oriented along a uniform direction are formed, at a high density, on this plane.

The width & width of said channels (12) may, for example, be designated at 1 μm each, and their pitch is several μm or less. The panel (11) on which such microscopic channels (12) have been configured at a high density are heated at $130 \sim 180^\circ\text{C}$. The horizontal orienting treatment is performed by mobilizing said panel (11) along the direction of the arrow (13) and by pressing the same onto the polyester film (8) for 1 ~ 5 sec. Microscopic channels bearing the inverted shapes of the channels (12) carved into the panel (11) become transferred onto the surface of the transparent electrode (9) of the polyester film (8) being pressed by the panel (11). This is a type of hot press. /3

Figures 3 (a) & (b) show an example of liquid crystal display element which has been subjected to the orienting treatment of the aforementioned application example, where the substrates (14) & (15) comprising of a pair of polyester films are mutually sealed, via a gap of 10 μm , by the

sealing adhesive (18), whereas the liquid crystal layer (21) is dispensed into the interior of the sealed structure. The external connection terminals (16) (16a, 16b, ...) & (17) (17a, 17b, ...) are configured on the terminal unit of the polyester film substrate (15) on one side. (19) is a liquid crystal dispensing hole, whereas (20) is a dispensing hole sealing agent, whereas (22) & (23) are electrodes configured respectively above the substrates (14) & (15). It was verified that the liquid crystal display element which has been subjected to the orienting treatment of the present invention bears performances utterly indistinguishable from those of a liquid crystal display element subjected to a rubbing orienting treatment of the prior art.

As the foregoing explanations have demonstrated, the liquid crystal display element subjected to the orienting treatment of the present application example is endowed with an effect of eradicating the problematic peeling & depletion of the transparent electrode even if the contiguity between the polyester film & transparent electrode is not particularly superior, for there is no need, in contradistinction with the prior art, to rub said transparent electrode with fibers (e.g., paper cloth, etc.). Unlike the treatment of the prior art for rubbing the entire substrate plane, furthermore, the orienting method of the present application example is peculiarly characterized by the treatability of partial sites bearing arbitrary shapes, and furthermore, this method is suitable for mass production.

Incidentally, the panel (11) serving as an orienting component is mobilized along the direction of the arrow (13) according to the application example shown in Figure 2, although it goes without saying that it is also possible to conversely mobilize & press the polyester film (8) against the panel (11).

Figure 4 is a diagram provided for explaining another application example of the present invention. A belt-shaped polyester film (25) with a thickness of approximately 100 μm which possesses, on the surface thereof, a transparent electrode and which has been wound around the winding frame (24) is drawn out by rotating the winding frame (24) along the direction of the arrow (26) and then guided, via the guide roller (27), in-between the drive rubber roller (28) & orienting roller (29). The rubber roller (28) is rotated, by a power mechanism, along the direction of the

arrow (30) and simultaneously pressed against the orienting roller (29) under a pressure of approximately 1 kg/cm^2 , whereas the orienting roller (29) is rotated along the direction of the arrow (31) by the rotating & driving action of the rubber roller (28).

A metal or dielectric material has been adhered to the surface of the orienting roller (29) by an appropriate mechanism (e.g., vacuum deposition, etc.), where microscopic channels with a depth of approximately $1 \text{ }\mu\text{m}$ and a pitch of $5 \text{ }\mu\text{m}$ or less are configured at a high density along a uniform direction, and at the same time, it is heated at $120 \sim 180^\circ\text{C}$.

In a case where the polyester film (25) has thus become introduced in-between the rubber roller (28) & orienting roller (29), microscopic channels become progressively transferred onto the surface of the display electrode formed by indium oxide, etc. on the orienting roller (29) side in a state where the orienting roller (29) is being rotated along the direction of the arrow (31).

The polyester film (25) onto which microscopic channels have thus been transferred is pushed toward the lower blade (33) [sic: Presumably “(32)”] side of a cutter and then cut as a result of the mobilization of the upper blade (33) along the direction of the arrow (34). The polyester film (25) thus cut is used as a substrate for a liquid crystal display element.

In this application example, too, channels on the surface of an orienting roller being rotated in a friction-free state become progressively transferred onto the polyester film, and therefore, the problematic peeling & depletion of the indium oxide or gold transparent electrode on the polyester film can be avoided, as in the previous application example. The orienting treatment of the present application example, furthermore, can be performed by simply transmitting a polyester film in-between rollers, and therefore, it is more suitable for mass production than the treatment of the previous application example, and an effect of contributing to a substantial cost depreciation of a liquid crystal display element can be achieved.

Figure 5 is a diagram provided for explaining an application example embodied by modifying the application example shown in Figure 2 by additionally orchestrating the method of the application example shown in Figure 4. In this application example, a columnar object (11') in

possession of an arc-shaped semi-circumferential plane is used as an orienting component. Large numbers of channels (12) aligned along a uniform direction are likewise formed on the semi-circumferential plane of the columnar object (11'), and the channels (12) are progressively transferred onto the polyester film (8) by pressing and rolling said object atop the polyester film (8) along the direction of the arrow (13). It is obvious that effects similar to those imputed to the previous application examples can be achieved in this application example as well. /4

Incidentally, the method of the present invention is equally effective for all liquid crystal display elements designed to use plastic films as substrates and to be subjected to horizontal orienting treatments such as elements of the dynamic scattering type, twisted nematic type, guest-host type, etc.

4. Brief explanation of the figures

Figure 1 is a diagram provided for explaining a horizontal orienting method known in the prior art, whereas Figure 2 is a diagram provided for explaining the horizontal orienting method of an application example of the present invention, whereas Figures 3 (a) & (b) are respectively a diagram which shows a plane view of a liquid crystal display element subjected to an orienting treatment in the aforementioned application example and a diagram which shows a cross-sectional view of the A-A' line of the same, whereas Figure 4 and Figure 5 are each diagrams provided for explaining the horizontal orienting methods of other application examples.

(8): Polyester film; (9): Transparent electrode; (11): Panel (horizontal orienting component); (12): Channels; (25): Polyester film; (29): Horizontal orienting roller; (28): Drive rubber roller; (11'): Columnar object (horizontal orienting component).

Figure 1

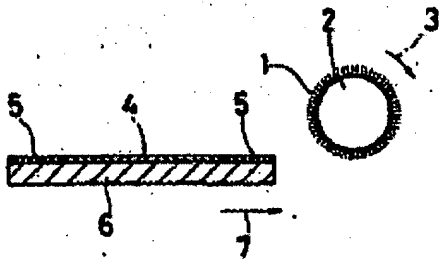
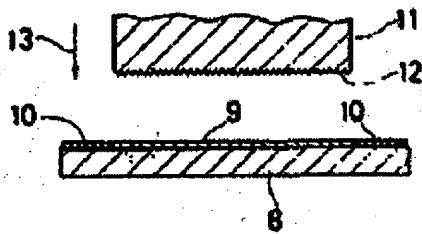
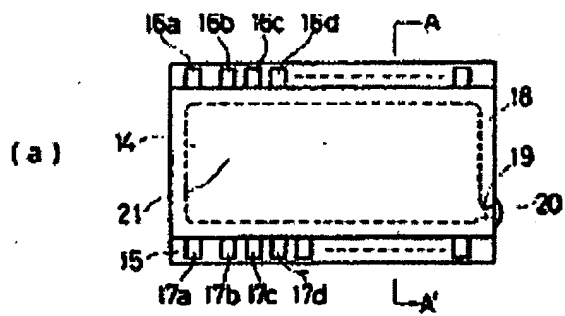


Figure 2



Figures 3

(a)



(b)

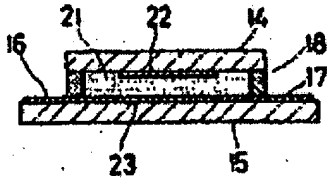


Figure 4

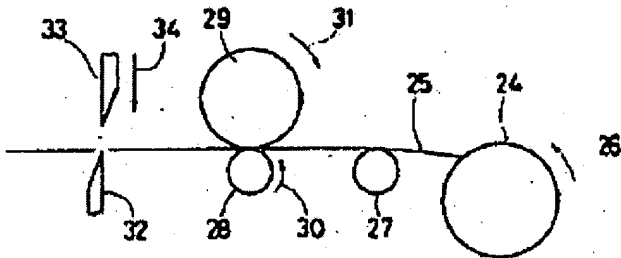


Figure 5

Fig 5

